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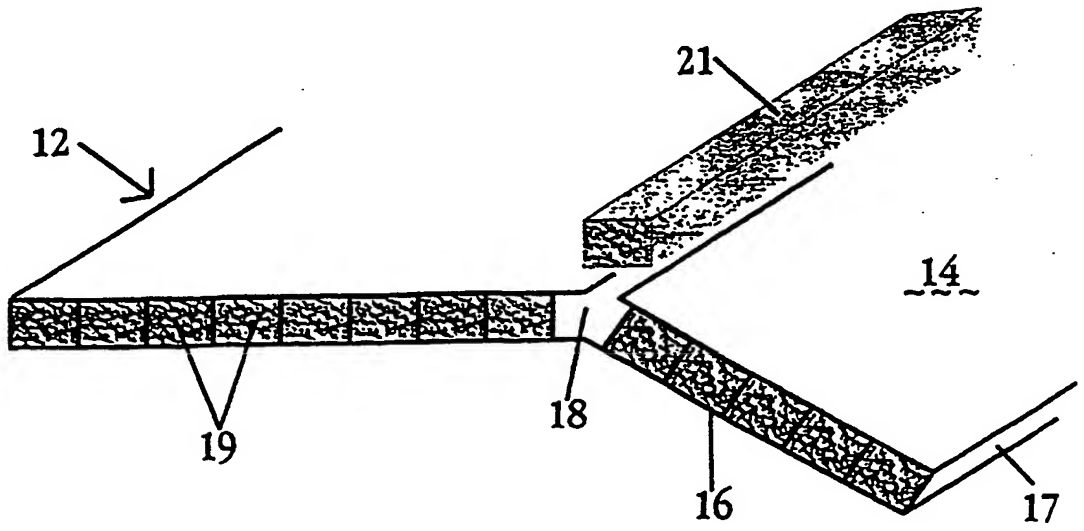

(57) Abstract

A composite sheet comprising a sheet of fluted material having a series of substantially parallel channels defined by at least one surface and a plurality of spaced walls; at least some of said channels being impregnated with a filler material.

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COMPOSITE SHEET

The present invention relates to a composite sheet, in particular a composite sheet which has a variety of uses such as a building material, as packaging material, as a panel or the like. The present invention also relates to a method of producing a composite sheet.

The invention will be described with particular reference to a sheet, such as a fluted sheet of suitable plastics material, commonly referred to as "flute board". This material is constructed with two spaced webs interconnected by a plurality of substantially parallel, spaced walls defining parallel channels or flutes. However, it will be appreciated that the principals of the invention can be applied to any sheet or board which has flutes or channels located therein.

Many different types of sheets or boards are used as multi-purpose sheets, as packaging or as building materials. For many years, flute board has been used for various applications, for example, for signage, boxes or storage containers. However, flute board has inherent disadvantages associated with its use as will be explained hereinunder.

Due to the physical characteristics of a planer sheet of flute board, when a bending movement is applied to the board along the length of a channel, one or more of the channels of the sheet of flute board is placed under pressure and the sheet of material may fold along the length of the channel under pressure.

It will therefore be appreciated that flute board may not maintain its normal rigidity when placed under bending forces. Similarly, many other known boards or sheets are also considered relatively weak and vulnerable to bending or collapsing when placed under appropriate bending forces.

For example, it is known to make boxes, or storage containers from flute board and corrugated board, and many industries use containers made from flute board for transport containers. However, such containers have inherent disadvantages in that the flute board may not maintain its strength or rigidity when placed under undue load. When a heavy load is placed in a container, it is not uncommon for the container to fold along a channel line and to collapse.

Flute board is also widely used in signage, such as for pointer boards for real estate advertising. When such signage is placed under load, such as from weather conditions or from vandalism, the sign is liable to fold along a channel line and be damaged.

A further disadvantage of flute board is that it is not generally constructed to withstand exposure to high temperatures. Still further, flute board does not have any acoustical, buoyancy or impact resistance properties.

However, many advantages arise from using flute board. For example, flute board is a relatively inexpensive material to manufacture and therefore the end cost to the consumer is relatively small.

The physical properties of flute board also have advantages. Traditionally flute board is made from a synthetic plastics material such as polypropylene, thus producing a lightweight sheet of material which is easy to handle. Therefore, when considering transport costs, the transportation of flute board is relatively inexpensive. The many other advantages of flute board include its ability to be easily cut with a knife or saw.

It is therefore desirable to provide an improved sheet which can be used in a manner similar to flute board and that is lightweight and easy to use.

It is also therefore desirable to provide a composite sheet that is relatively rigid and has an improved strength compared to pre-existing boards.

It is also desirable to provide a composite sheet which has thermal insulation properties.

It is also desirable to provide a composite sheet which is easy to cut to a required shape.

It is also desirable to provide a composite sheet which has improved acoustic properties to provide soundproofing.

It is also desirable to provide a composite sheet which does not warp.

It is also desirable to provide a composite sheet which, prior to use is portable and readily transportable.

It is also desirable to provide a composite sheet which has increased spanning compared with pre-existing boards due to an increased resistance to bending forces.

It is therefore desired that the present invention provides a composite sheet which obviates some of the problems of traditional sheets, in particular flute board. According to one aspect of the present invention there is provided a composite sheet for use as for example, a building or construction material, packaging or the like, the composite sheet comprising:

a sheet of fluted material having a series of substantially parallel channels defined by at least one surface and a plurality of spaced walls;

at least some of said channels being impregnated with a filler material.

Preferably, the filler material is an expanding material, such as an expanding synthetic plastics foam material.

In one form of the invention, the sheet of fluted material is flute board, made from, for example a synthetic plastics material such as a polyethylene or a polypropylene.

In one form of the invention the filler material may be a foam, such as a polyurethane foam.

According to another aspect of the invention there is provided a method of producing a composite sheet comprising forming a sheet of fluted material with a plurality of substantially parallel channels defined by at least one surface and a plurality of spaced walls, filling at least some of the channels with a filler material and allowing the filler material to set within said at least some of the channels.

Preferably, the filler material is an expandable material such as an expanding synthetic plastics foam material, such as foamed polyurethane.

The method of impregnation of the channels is dependent upon many factors, including the size of the channels. The appropriate method of impregnation must be chosen to ensure that the size of the cavity of the channel does not hinder distribution of the filler material, which, if incorrectly carried

out, may cause back expansion toward the filling end of the channel, thus blocking the channel against the further flow of the filler material.

In one embodiment the fluted material may be heated prior to impregnation. Heating of the material assists in lowering the viscosity of the filler material as it moves through the channels, therefore aiding quick and even distribution.

In a still further form of the invention the flute sheet may be positioned at an angle during impregnation of the filler material to assist in downward distribution of the material through the channels.

In a still further form of the invention the strength of the fluted sheet may be increased by inserting one or more substantially rigid elongated members, such as wires or rods through the channels prior to impregnation of the filler material. When the filler material is impregnated into the channels the wires or rods are encapsulated by the filler material and act as reinforcing for the sheet.

It has been found that a particular advantage of the sheet of the invention is that the impregnated sheet may be welded. Attempts to weld an un-impregnated sheet will cause the channels to collapse, thus rendering the sheet useless. Impregnation of, for example, an expanding material able to withstand high temperatures will enable the impregnated sheet to be welded without damaging the flute structure.

In one preferred form, a sheet of the invention has all channels thereof impregnated with an expandable material. In another form, only predetermined or selected channels are impregnated with the expanding material. In carrying out the impregnation, should a channel be incorrectly impregnated, it is possible to cut a surface of the channel and bend the channel along its length to release the incorrectly located filler material.

Embodiments of the present invention will now be described with reference to the accompanying drawing in which:

Figure 1 is a diagrammatic end view of a composite sheet according to one embodiment of the invention;

Figure 2 is a diagrammatic isometric view of the composite sheet of Figure 1; and

Figure 3 is a diagrammatic view of a further embodiment of the invention.

In order that the invention may be more readily understood we shall hereinunder describe the features of the invention.

Referring to the drawings, there is illustrated one embodiment of a composite sheet made in accordance with one aspect of the present invention. The sheet 12 comprises an upper surface 14 spaced from and substantially parallel to a lower surface 16. The upper and lower surfaces 14 and 16 are separated by a plurality of substantially parallel walls 17 which define with the upper and lower surfaces, channels or flutes 18.

Such flute material is well known in the art and will not be described in any further detail. The material is generally formed of a synthetic plastics material such as polyethylene or polypropylene, but may be made of any other suitable material including other synthetic plastics material, cardboard or paperboard or the like.

The channels 18 are filled with a filler material 19 which, in this embodiment, is a synthetic plastics foam material comprising foam polyurethane. For example the type of polyurethane foam may be AU 270. The composite sheet so formed has substantially increased rigidity and strength due to the structure of the filler material which is able to maintain the spacing between the upper and lower surfaces 14 and 16 and greatly resist bending forces applied to the sheet 12. It will be understood that the filler material 19 substantially fills the channels 18. Once the filler material 19 has foamed and set in each channel, it is referred to as a channel filler.

In the present embodiment, in achieving the desired impregnation of the channels 18 with the filler 19, a sheet of fluteboard having channels 10mm square and an overall dimension of approximately 2000 to 3000mm by 1000 to 1500mm is used. Preferably the length is 2440mm and width 1220mm.

Preferably the fluteboard is placed on a slated table which allows a direct heat from infra-red lamps to substantially evenly heat the sheet 12. Alternatively the sheet 12 may be heated by an indirect heat, such as in a heat controlled environment. For example, a heat controlled container or vessel.

In the former method the infra-red lamps are supported above and below the table to heat the respective surfaces 14 and 16 and the walls 17. The sheet 12 is positioned at an angle between 30° and 40°, but preferably at 35° to the vertical and the sheet 12 is heated as hereinbefore described to a temperature of between 45° and 50°C.

The polyurethane filler material 19 is preheated to approximately 35°C prior to introduction into the elevated ends of the channels 18. The filler material 19 is introduced into channels 18 and allowed to run down the channels. Once the filler material 19 reaches approximately the middle of the channel 18 the filler material 19 commences to foam, thereby expanding to evenly and substantially fill the channel 18.

It is expected that from introduction of the filler material 19 it would take approximately 160 seconds to 180 seconds for the filler material to set.

Alternatively the angle of the sheet 12 may be substantially vertical in which case prior to introducing the filler material at upper ends of the channels 18, the lower ends of the channels are blocked or capped in any suitable manner. On introducing the filler material 19 to the channels 18 the filler material 19 flows to the lower end of the channel where it foams and rises upward to substantially evenly fill the channel 18.

Alternatively the angle of the sheet 12 may be substantially horizontal in which case the filler material 19 is injected into the channels 18 via at least one aperture extending through either or both surfaces 12, 14. Preferably the apertures are located substantially at the middle of the channel.

Alternatively the filler material 19 can be introduced at one end of channel 18 and thereafter capping of this end of the channels thereby forcing the foam to expand torward the other open end of the channel 18.

As shown in Figure 2, one or more of the channel fillers may be removed from relevant channels by slitting appropriate upper or lower surfaces 14 or 16 and bending the sheet 12 enabling the channel filler 21 to be removed. This may be required if it is necessary to bend the composite sheet at a relatively sharp angle. Otherwise, the sheet may be compressed along the line of a desired bend to facilitate bending thereof.

Referring to Figure 3, there is illustrated a composite sheet made in accordance with the present invention in which only every second channel 18 is filled with filler material 19. This arrangement is appropriate where the sheet is to be bent around a relatively sharp curve.

It will be appreciated that a sheet made in accordance with the embodiment shown in Figure 1 may be curved by heating the composite sheet with hot air. With such heating, the material of the invention may be formed into complicated curved shapes, such as to form the curved sides of a boat or the like.

It will also be appreciated that a plurality of panels in accordance with the present invention may be welded or otherwise laminated together to form multiple composite panels of increased strength and durability. It will also be appreciated that the composite material of the invention may be formed using a corrugated board, such as corrugated cardboard, or similar board material formed of synthetic plastics material. The use of "flute board" is preferred only.

Claims

1. A composite sheet comprising

a sheet of fluted material having a series of substantially parallel channels defined by at least one surface and a plurality of spaced walls;

at least some of said channels being impregnated with a filler material.

2. A composite sheet according to claim 1 wherein said filler material is an expanding material.

3. A composite sheet according to claim 2 wherein said expanding material is a synthetic plastics foam.

4. A composite sheet according to any one of the previous claims wherein in forming said composite sheet said filler material is introduced at respective co-located ends of said at least some of said channels whereby said filler material flows toward the other ends of said at least some of said channels.

5. A composite sheet according to claim 4 wherein said filler material sets within a respective channel so as to make said composite sheet substantially rigid.

6. A composite sheet according to claim 5 wherein said sheet of fluted material is heated prior to the introduction of the filler material into said at least some of said channels.

7. A composite sheet according to claim 6 wherein said sheet of fluted material is heated to a temperature in the range of 45° to 50°C.

8. A composite sheet according to any one of claims 4 to 7 wherein said sheet of fluted material is placed at an acute angle to the horizontal on introduction of the filler material.

9. A composite sheet according to claim 8 wherein said sheet of fluted material is placed at an angle in the range of 30° to 40° with respect to a horizontal plane.

10. A composite sheet according to claim 4 wherein said sheet of fluted material is placed substantially vertical on introduction of the filler material.

11. A composite sheet according to claim 4 wherein said sheet of fluted material is placed substantially horizontal on introduction of the filler material.

12. A composite sheet according to claim 11 wherein said at least some of said channels have at least one aperture located in said at least one surface of said sheet of fluted material for introducing said filler material.

13. A composite sheet according to any one of the preceding claims wherein said at least some of said channels have one or more substantially rigid elongated members inserted therethrough prior to the introduction of said filler material.

14. A composite sheet according to any one of the preceding claims wherein at least one surface of said sheet of fluted material may be cut along a channel so as to facilitate bending of said composite sheet.

15. A composite sheet according to claim 14 wherein said filler material is removable from said channel.

16. A method of producing a composite sheet comprising the following steps:

forming a sheet of fluted material with a plurality of substantially parallel channels defined by at least one surface and a plurality of spaced walls;

filling at least some of the channels with a filler material;

allowing the filler material to set within said at least some of the said channels.

17. A method of producing a composite sheet having a sheet of fluted material with a plurality of substantially parallel channels defined by at least one surface and a plurality of spaced walls, said method comprising the following steps:

filling at least some of the channels with a filler material;

allowing the filler material to set within said at least some of the said channels.

18. A method of producing a composite sheet according to claims 16 or 17 wherein said filling step further comprises the step of introducing said filler material at respective co-located ends of said at least some of said channels.

19. A method of producing a composite sheet according to claim 18 further comprising heating said sheet of fluted material prior to said introducing step.

20. A method of producing a composite sheet according to claim 18 to 19 further comprising placing said sheet of fluted material at an acute angle to the horizontal on introducing said filler material.

21. A method of producing a composite sheet according to claims 18 or 19 further comprising placing said sheet of fluted material substantially vertical on introducing the filler material.

22. A method of producing a composite sheet according to claims 18 or 19 further comprising placing said sheet of fluted material substantially horizontal on introducing the filler material.

23. A method of producing a composite sheet according to any one of claims 16 to 22 further comprising inserting one or more substantially rigid elongated members into said at least some of said channels prior to said filling step.

24. A method of producing a composite sheet according to any one of claims 16 to 23 further comprising cutting at least one surface of said sheet of fluted material along at least one of said channels so as to facilitate bending of said composite sheet.

Fig 1

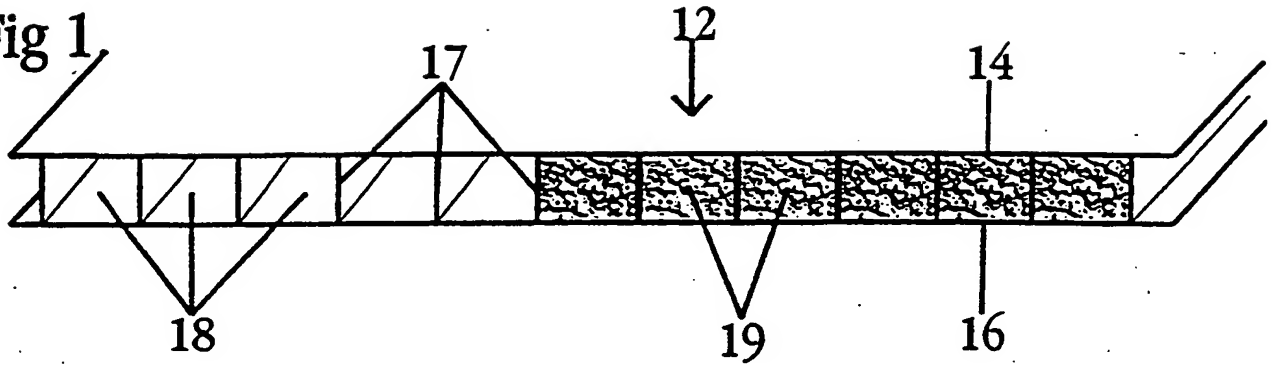


Fig 2

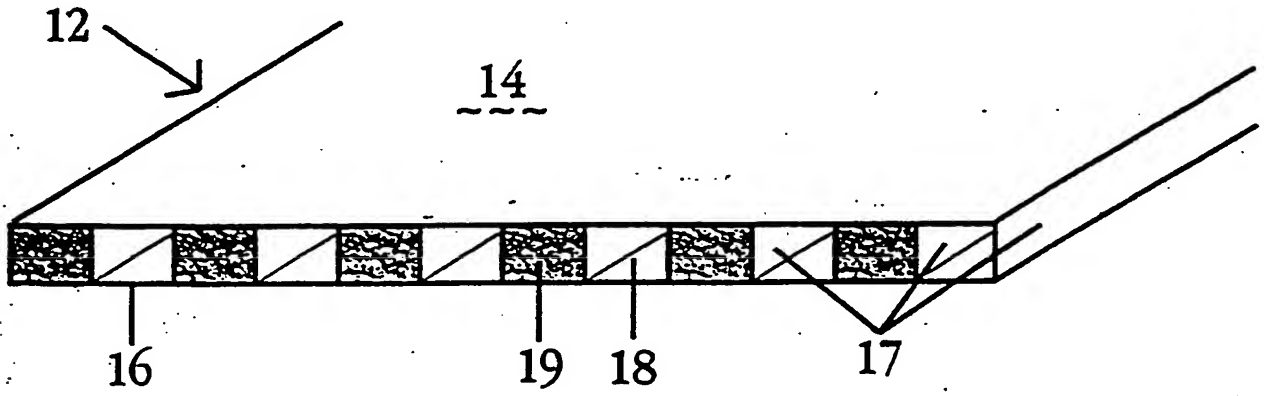
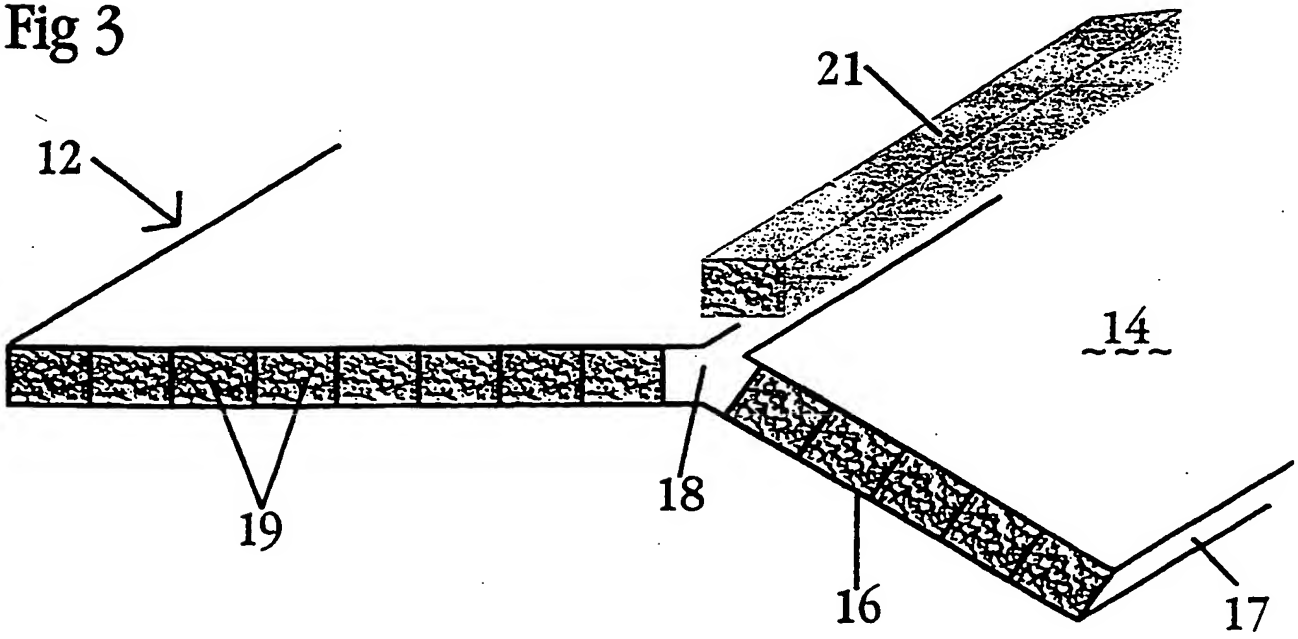


Fig 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00427

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B32B 3/12, 3/30, 5/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC[7] AS ABOVE

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NIL

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent on- line WPAT: IPC as above with key words fill+ foam+ occup+ flut+ groov+ corrugat+ channel+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Accession No. 88-004741, Class P73, JP 62- 270330, A, (Shinwa Package KK), 24 November 1987. Whole Document	1- 12, 16- 22
X	Patent Abstracts of Japan, JP 08- 057994, A, (Mitsubishi Alum Co. Ltd.), 5 March 1996. Whole Document	1- 12, 16- 22
X	Patent Abstracts of Japan, JP 07- 195595, A, (Ikeda Bussan Co. Ltd.), 1 August 1995 Whole Document	1- 12, 16- 22

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search
21 June 2000

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00427

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Patent Abstract of Japan, JP, 10- 100325, A, (Bando Chem. Ind. Ltd. Kajima Corp.), 21 April 1998	
X	Whole Document	1- 12, 16- 22
	Derwent Abstract Accession No. 19124C/11, Class A25, P73, (A32), JP 55- 014235, A, (Matsushita Elec. Works), 31 January 1980	
X	Whole Document	1- 12, 16- 22
	DE 3940986, A1, (Messerschmit- Bolkow- Blohm GmbH), 13 June 1991	
X	Column 2, lines 36- 29; Claim 1; Fig	1-6, 8-12, 16- 18, 20- 22
	US 4 565 723, A, (Hirsch), 21 January 1986	
A	Whole Document	1- 24

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00427

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
DE	278988	EP	432426				
US	4565723	JP	59- 145137	EP	109388	DE	3371489
AT	382664						

END OF ANNEX